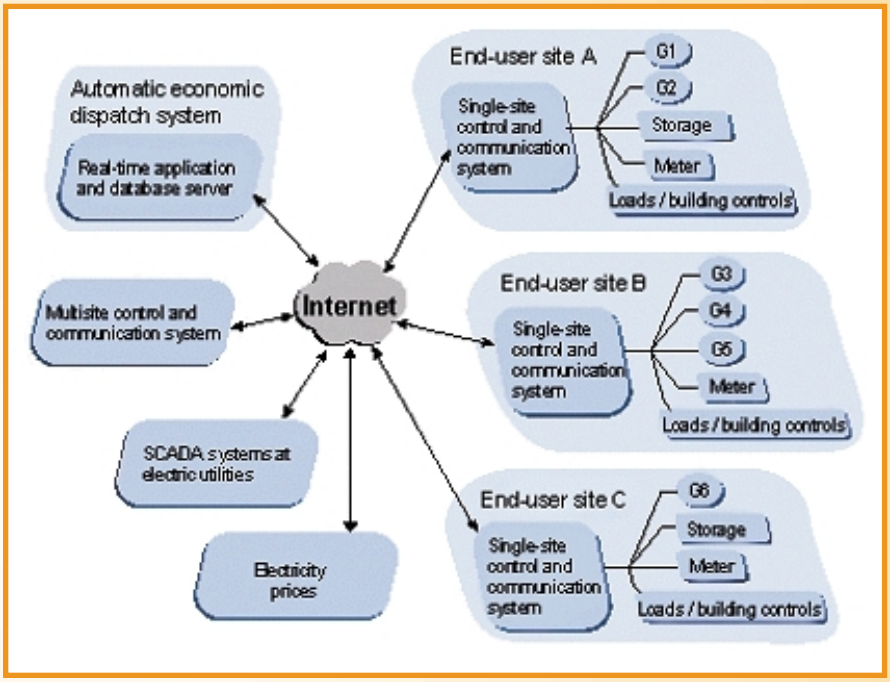
Communication & Controls

Tech Brief

Distributed Energy Resources (DER) are a suite of onsite, grid-connected or stand-alone technology systems that can be integrated into residential, commercial, or institutional buildings and/or industrial facilities. These energy systems include distributed generation, renewable energy, and hybrid generation technologies; energy storage; thermally activated technologies that use recoverable heat for cooling, heating, or power; transmission and delivery mechanisms; control and communication technologies; and demand-side energy management tools. Such decentralized resources offer advantages over conventional grid electricity by offering end users a diversified fuel supply; higher power reliability, quality, and efficiency; lower emissions; and greater flexibility to respond to changing energy needs.

Advanced communication and control (C&C) technologies are needed to enable integration and interoperability functions of a broad range of distributed energy resources. These technologies offer a digitally controlled, "smart" electricity network with broad-band communication capabilities. Through improvements in communication, information management, and controls, DER can be aggregated to operate in grid-connected or stand-alone modes. These advancements promise to transform the electricity industry into customer-managed "virtual utilities."



Aggregated Communication and Controls System (Courtesy of E Source)

Applications

C&C technologies can be used in many kinds of DER systems. However, open, standard C&C protocols are needed to provide interoperability, scalability, and "reconfigurability" to meet a wide range of application needs. C&C technology must be continually advanced to meet the challenge of providing real-time, interactive, customer-managed service networks for an evolving electric infrastructure.

Market Potential

The estimated market potential for C&C technologies is based on several assumptions:

- 5-10% energy savings achieved through advanced C&C technologies
- 30% ultimate market share
- One-year payback required by the end user

Since the market for electricity is nearly $250 billion domestically and $1 trillion worldwide, the market potential for C&C technologies is between $3.75 billion and $7.5 billion domestically, and between $15 billion and $30 billion worldwide.

Environmental Benefits

By enabling demand-side management and smart control, advanced C&C technologies will help maximize the full potential of DER in mitigating greenhouse gas emissions. Natural-gas-based distributed generation systems are significantly less polluting than coal-based power generation plants. Integrated cooling, heating and power systems further increase efficiencies and reduce pollution.

Each kilowatt-hour saved through real-time metering and demand-side management will offset about 590 grams of carbon dioxide. The same offset applies to renewable resources.

C&C systems are beginning to make their way into many applications. RealEnergy will develop a premium power park in Pleasant, California, that provides economically optimal control of power generation and quality in real time using Silicon Energy's distributed generation management system. Other examples include Electrotek Concept's system to aggregate backup generators in the Long Island Power Authority territory; Sixth Dimension's automatic dispatch system that allows customers to participate in load management in California's energy market; and a project with Encorp to produce next-generation C&C systems for a broad range of 50-kW to 5-MW+ distributed energy systems.

The impact of this early market penetration is best illustrated by the Los Angeles Department of Power and Water's installation of smart real-time electricity meters from Siemens Power Transmission and Distribution. The meters will be installed for 3,400 of the Department's large business customers, allowing them to manage and forecast their energy loads in real time. This technology is expected to reduce electricity bills by 15 percent and free up enough energy to power 240,000 households.

Program Goals and Activities

Advanced, lower-cost C&C devices will help DER meet the nation's power generation, transmission, and distribution challenges. These devices will help reach the DOE Office of Power Technologies' goal of supplying 20 percent of U.S. electric capacity additions (~50 GW) with distributed energy systems by 2010. DOE's goal for C&C technologies is to achieve a 10-percent energy savings with a payback of technology investment in one year.

Initial activities have focused on facilitating formation of an industry/government partnership to jointly pursue research, development, demonstration, and deployment (RD^3) in C&C technology, and to develop a comprehensive life-cycle RD^3 plan.

The program's progress to date is marked by the following activities:

- An Executive Summit in May 2001 forged opinions on electricity valuation in the current economy and outlined information requirements with associated barriers.
- A Technology Roadmap Workshop in September 2001 defined functional objectives for C&C technologies and identified high-priority activities.

Another high priority is demonstration of a large DER network with multi-MW capacity that can assess the overall impact of DER on grid performance under real-world conditions. Demonstration projects will show the importance of interoperability and conformance among existing and new DER systems; information flow and management; peer-to-peer communications and distributed control strategies; smart control and autonomous protection; and incorporation of economic models, market prices, and demand-side management. A phased approach, from initial integration with the feeder line through integration with substations, will begin with a demonstration project in 2005 at a single end-user site with an aggregated capacity of approximately 1 MW. The project will be implemented in 2008 at multiple end-user sites with an aggregated capacity of 5-10 MW, and in 2010 in a smart utility application with aggregated capacity of more than 10 MW.

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